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"WHAT'S INSIDE THE POTATO"

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The subject "What's Inside the Potato" might be discussed in a number of different ways, depending on the viewpoint of the speaker. The grower sees in the potato a source from which he hopes to pay the interest on the mortgage. The housewife sees in it a source of cheap wholesome food. The morphologist interested in the origin and structure describes the potato tuber as a thickened stem having the cells mostly filled with starch as a reserve food for the new plants. The eyes are the promise of the future branches. The skin differs from the surface covering of the rest of the plant by being formed of a layer of delicate cork with its accompanying lenticels; and the fibrous framework, as well as the pith is continued from the leaf-bearing stems into the tuber with relatively little change. Liquids move from part to part, most readily through the fibrous tissue and not through the proper pith.

The anatomist would say that the potato (tuber) may be divided into four rather distinct parts or zones which are known as (1) The envelope or skin; (2) the cortical layer; (3) the external medullary area and (4) the internal medullary area, and then he would proceed to describe each zone and the tissues and cells of which each part is made up.

To all of these one potato would be very much like all other potatoes. To be sure, the grower wants the variety which will give the greatest return on his labor and investment; the intelligent housewife knows that there are differences in potatoes with respect to their cooking quality; the anatomist sees slight differences in the tissues of which the tuber is made up but all these differences are quite insignificant when compared with the variations which are met by the plant breeder. He finds that there are numerous things inside the potato, many of which will never come to light unless the most approved plant breeding methods are applied. To

him the potato is a living organism subject to the same laws of heredity as other plants and animals, sensitive to environmental conditions, and prone to the attacks of numerous diseases and insect pests. Differences are found not only in color of skin, shape of tuber, depth of eye, yield and cooking quality but also in their reaction to various diseases. These differences or variations are dependent on factors or genes carried in each of the cells inside the potato. The character produced by the plant is determined by the combination of genes which is present in the cells of the potato, and is influenced in its development by the environment which makes or mars the character even when the most desirable combination of genes is present.

Each individual variety has its own complement of genes within its cells and the reason there is more than one variety of potato is because the genes of each differ from those of another. These genes and the resulting characters of the plant with all the differences between them are the materials with which the plant breeder works. These are what he knows to be inside the potato. But the question might be asked, how do all these variations in characters occur and how do new varieties of potatoes originate? The grower knows from his experience that if he plants tubers or seed pieces of a variety of potatoes, very little, if any variation, will occur except the variation which is due to disease or lack of fertilizer or moisture or some other environmental condition, i. e., "like begets like." As a result not much improvement can be made by selecting within a variety except to keep the stock free from disease. Sudden changes which cannot be accounted for by the normal laws of inheritance and which the plant breeder calls mutations may occur but these are found very infrequently. A number of these mutations have been studied and described. Clark (2) has described several which have occurred in the color of the skin and eyes. East (3) and Salaman agree that mutations of this sort are extremely rare occurrences. Nevertheless they do occur, and Salaman classifies them according to whether they are due to the acquiring of a character or to the loss of the same, whether they affect the tuber only or the whole plant. Mutations due to the loss of a character are by far the most common. There are a number of instances where the red tuber loses part of its red color and becomes "splashed" or all of its color and becomes white while purple tuber varieties may produce red, purple-splashed or white. Somewhat similar changes have been observed for flower color. Mutations due to the acquisition of a

character or positive mutations are much rarer. In these cases a white-tuber variety will throw a red-tuber sport or a partially colored variety will throw a fully colored one. A sudden change from smooth skin to russet skin has been known to occur, but this change is also rather infrequent. East (3) carried out some carefully controlled studies on the occurrence of somatic mutations in the potato, during the course of which five permanent changes from pink to white tubers, two permanent changes from long to round tubers and four instances of changes from shallow to deep eyes were observed. It is readily seen that such changes even if they occurred more frequently would be quite unimportant from the standpoint of the development of new potato varieties.

Clark (1) states that of 380 varieties which have originated in the United States and have at one time or other been introduced to the commercial trade, only 22 or less than 7% may have originated as so-called sports or mutations. Of the 22 reported as sports, 4 are white-tubered from varieties with colored tubers and 4 are late maturing variations found in early varieties. The meager information regarding the other 14 furnishes no basis for determining whether they were actual mutations or whether they were mixtures carried in the seed stock or volunteers which had persisted in the soil from some preceding crop.

The other 358 varieties were produced by growing plants from true seed. True seed is a product of sexual reproduction in plants and is the result of the fusion of male and female gametes. These gametes carry the genes which make possible the development of the various characters of the potato plant, and as half of these are contributed by the mother plant and half by the father the resulting progeny will be like the mother in some characters, like the father in others and still other characters may be brought to light that were not evident in either of the parent varieties.

No variety has all the characters which it is desirable to obtain. As soon as such a variety is found the potato breeders' work will be done. Some of the most desirable characters such as resistance to certain diseases are not found in any of the commercial varieties. All of our best varieties are susceptible to late blight, for example, and a late blight resistant potato having all the other characters of commercial importance has been one of the needs of the potato growers for nearly 100 years. Many varieties have been produced in an effort to obtain a variety resistant to this disease and some of them have been promising from the standpoint of resistance but they have all been discarded for one cause or another. Recent

work has shown however that even if the problem is a difficult one it is not impossible to solve. A number of varieties and species are available at present which show more or less resistance to this disease. None of these are especially desirable from the commercial standpoint but all of them show promise as breeding material and work is being carried on at present to combine the resistance to late blight with other characters of commercial importance.

Scab is another disease which is being attacked by the same methods. Several varieties are available which are at least partially resistant to scab. The most resistant one occurred in a cross between sister and brother seedlings at Presque Isle, Maine. It is heavily russeted and as it was the only one showing russeting in a population of approximately 2,250 progeny of this cross it is assumed to be a mutation. It is not a high yielder and will probably never be distributed to the growers but it is being used as a parent with the expectation that it will transmit the resistance to scab to its progeny, some of which it is hoped will be high yielders.

Other diseases that have claimed the attention of growers and plant breeders for a number of years are the so-called "running out" diseases caused by virous infection. One of the commonest of these is mild mosaic. Recent work has developed a number of varieties resistant to mild mosaic and has shown definitely that this resistance is heritable. Two of these varieties, Katahdin and Chippewa, have resistance to mild mosaic, combined with other characters of commercial importance, and as a result they are being distributed to growers in various parts of the United States. If the attacks of one virous disease can be controlled by the production of resistant varieties, it should be possible to produce varieties resistant to the attacks of other virous diseases such as leaf roll and spindle tuber. None of the varieties tested up to the present time has shown resistance to either of these diseases and it is quite possible that these characters are not available in any of the cultures with which we are working. If this is so it will be necessary to continue the search in our own and in foreign countries until all the possibilities of finding such characters are exhausted.

In recent years two expeditions, one to Mexico and the other to South America, under the leadership of the Division of Foreign Plant Introduction have been made. These expeditions brought back a large number of varieties and species of potatoes which are now being tested for various characters and which it is hoped will contribute valuable characters for use in the breeding work. In

the search in foreign countries for material it is not expected that varieties will be found which will compete with the best American varieties. In fact most of the varieties introduced would be discarded by the grower as being useless from the commercial standpoint. Many of them will be discarded by the plant breeder also since they will be found to have nothing to contribute. Others will appear valueless if yield or shape are considered, but they may possess characters which will improve the food quality of the potato or tend to decrease the cost of production and so repay the cost of the expeditions sent to secure them. The search has become then not one for varieties of potatoes which will compete with the best commercial American varieties but it becomes a search for what's inside the potato in the form of genes which determine the characters in the growing plant. After the most desirable genes are found it is the work of the plant breeder to combine the best of these in new varieties which will be an improvement on the old in such characters as shape, shallowness of eye, yield, cooking quality and disease resistance. The value of such varieties to consumers and growers would be very great. A higher market quality than exists in many of the present day commercial varieties is desirable from the standpoint of the consumer. Varieties producing rough tubers with deep eyes in which there is much waste in peeling should be replaced by varieties with smooth tubers which have shallow eyes. The grower spends millions of dollars yearly in fighting diseases, and in spite of his efforts the average annual losses from these pests for the years 1928-1930 were approximately 80 million bushels with a farm value of 63 million dollars. By the use of disease resistant varieties many of these losses could be prevented.

Varieties of commercial potatoes cannot be created by a wave of the hand or in a day or in a year. Any breeding program is a long time program. It is true that thousands of new varieties are produced each year in our breeding work but many of them are discarded on sight. Those which are selected must be tested for yield, cooking quality and disease resistance. In these preliminary tests many are again discarded. If one has the good luck to survive it must be disseminated to the various cooperating State Experiment Stations where tests are made to determine its adaptability to various conditions of environment. If it still survives it takes several years to produce enough seed to get it into commercial production. The Katahdin variety for example was produced in

1923 and is just now going into production and as far as the records show no time was lost in making the various tests and getting it out to the grower.

In spite of the difficulties involved and the length of time required, potato breeding is a worth while enterprise and offers the potato grower the only possible solution to many of his problems. The closest cooperation between plant breeders, plant pathologists and growers must be continued if the best results are to be attained. A summary of the most important results of the work of the United States Department of Agriculture shows that one variety has been produced as early as the Irish Cobbler, with much better shape and shallower eyes but slightly below it in yield. Another variety is resistant to scab but again is not a high yielder. Several others are apparently resistant to late blight but it is doubtful if any of them will be distributed to commercial growers. Two yellow fleshed varieties have been produced which have been found to contain more Vitamin A than the white fleshed varieties. This may add somewhat to the food value of the potato. A number of others have been produced resistant to a virous disease and have combined with this resistance good shape, shallow eyes, and high yielding ability. One of these, Chippewa, is still under test by the State Experiment Stations to determine its range of adaptability. There is no seed for general distribution. The other one, Katahdin, has been tested rather extensively for the last three years and altogether there were about 60 acres of certified seed of this variety grown in 1933. These results are important from the standpoint of the growers, but they are extremely important from the standpoint of the plant breeder since they show the possibility for more valuable developments in the future potato improvement work.

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POTATO VIROUS DISEASES IN 1933

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This review summarizes very briefly about 130 papers, abstracts, and reports that have come to the writer's attention since his preparation of a review for 1932 (42).

There has been an unusual production of general books on plant virous diseases and their insect vectors (15, 92, 115, 119), of general articles on this subject (10 chapter IX, 56, 78, 114, 116, 118), and of articles or book chapters on potato virous diseases as a whole (15 chapter VII in part, 45, 84, 106, 115 chapter XII). These show that the exact nature of a virus remains undiscovered.

The naming and classification of virous diseases seem further than ever from a simple solution (20, 26, 50, 66, 69, 70, 77, 88, 98, 105, 112, 126).

Experimental transmission and field observation have thrown more light on the question of the kinds of insects to be fought (30 p. 133, 38, 40, 66, 70, 71, 77, 79, 85, 88, 98, 108, 116, 127).

Natural dissemination varies from place to place (38, 60, p. 9 and 81-2, 80, 84, 88, 116, 121, 127, 128, 129) and apparent'y can occur for a half-mile or more (79, 80).

The known extent of geographical distribution is still being enlarged (9, 29, 45, 47, 91) and surveys disclose that potato virous diseases are still with us in varying amounts (30 p. 133, 31 p. 122-3, 82, 91).

Unfavorable growing conditions are still claimed by some German ("Abbau") workers as being the cause of virous diseases (17 p. 806, 18, 62, 63, 64, 67, 73, 86, 87, 119, 125, 133), but usually other reasons are given for variation of the virous-disease problem with the environment (21, 32, 33, 34, 35, 36, 37, 38, 39, 40, 45, 59, 61 p. 12, 64, 67, 68, 71, 93, 101 p. 406, 108, 116, 121, 127, 128, 129, 130), and virous diseases are still recognized as often being important in seed-improvement programs (24, 32 p. xxxiv, 36, 37, 38, 39, 44, 51 p. 32, 54 p. 46, 55 p. 47, 56, 58 p. 23, 60 p. 9 and 81-2, 123, 127, 128, 129, 130).

Without growing the plants there seems to be no practical rapid method of tuber-indexing, in spite of the effects of virous diseases or degeneration (Abbau type) or both upon electrical potential (4, 43, 64, 65, 86, 125, 131); discoloration of tissue especially in contact with metal (5, 16, 18, 64, 65, 83, 86, 125); electrical conductivity,

penetration by stains, darkening of sap, sap viscosity, and Röntgen diagrams (5, 16); electromotive force of injurious current (7); absorption of water (16, 18); retention of water against alcohol (65, 99); moisture equilibrium, resistance to pressure, elasticity, and viscosity of cooked paste (16); chemical composition (18, 27, 88, 93, 104, 109); pH (18); decomposition in toluolized water (65); fluorescence and luminescence with ultra-violet light, etc., (64, 65, 83, 125); and sprouts (52 p. 28-9, 109).

Scientific knowledge is increasing about the effects of virous diseases upon the physiology of the plant (10 p. 268-272, 11, 12, 13, 14, 27, 71, 74, 80, 81, 88, 103, 104, 107, 109, 120, 126, 127) and upon the plant's structure (107, 109, 112).

Data are being accumulated with respect to the effects on yield (11, 30 p. 133, 31 p. 122-3, 44, 45, 67, 76 p. 30 and 40-1, 79, 80, 101 p. 378).

Practical control is making progress through seed plots (6 p. 116, 51 p. 32, 52, p. 28-9, 57 p. 46, 84, 91, 123) and other methods (8, 25, 35, 45, 51 p. 32, 57 p. 46, 75, 76 p. 30 and 40-1, 79, 82, 84, 85, 88, 94 p. 68-9, 97, 104, 111, 121, 123).

Seed stocks are being increased that are free from masked mosaic and streak diseases (80, 88).

New data are available on various mosaic and streak diseases, and crinkle (1, 2, 12, 14, 19, 20, 21, 22, 25, 26, 29, 30 p. 133, 31 p. 122-3, 36, 40, 47, 50, 52 p. 28-9, 61 p. 12, 66, 67, 68, 69, 70, 71, 72, 75, 76 p. 30 and 40-1, 77, 79, 80, 81, 84, 85, 88, 89, 91, 94 p. 68-9, 95 p. 27-8, 96, 98, 103, 104, 105, 107, 110, 111, 113, 117, 118, 122, 126, 127, 129, 132 p. 47-8), leaf roll (3, 10 p. 268-272, 11, 12, 13, 21, 25, 27, 40, 50, 52 p. 28-9, 59, 60 p. 9 and 81-2, 61 p. 12, 67, 68, 71, 79, 80, 88, 91, 93, 104, 107, 108, 109, 120, 121, 124, 128, 129), pseudonetnecrosis (94 p. 20-1), spindle tuber (9, 25, 76 p. 30 and 40-1, 79, 80, 84), curly-dwarf (93), yellow-dwarf (30 p. 133, 31 p. 122-3, 46 p. 18), yellowtop (79, 80), witches' broom (89), calico (55 p. 47, 84), and transmissible "low-growing habit" (89).

Psyllid yellows has not been proved to be a virous disease (41, 102) and rather seems not to be one (28 p. 9, 84).

Giant hill also is unsolved as to cause (84, 89).

The evidence tends to show that some but not all forms of internal spotting or browning of tubers are due to virous disease (17 p. 792-3, 23, 48, 49, 53, 97, 100).

In the list of references are eight (marked by *) seen only by title. A few others are not included here or in the previous list of this series but may be found listed by Morstatt (90) for 1932. For

reasons of economy some titles are abbreviated, as is sometimes also the name of a periodical after the first citation from it.

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TESTING THE IDENTITY AND PURITY OF POTATO VARIETIES IN GERMANY

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The potato wart (*Synchytrium endobioticum*) causes the farmer great concern in all European countries carrying on trade in seed potatoes. When it occurs on a farm, difficulties arise since the potatoes may no longer be sold but must be used up in one's own organization in order that the disease does not spread further. To meet these difficulties, it is planned to shift the growing of potatoes in Germany to the cultivation solely of wart resistant varieties and thereby prevent the occurrence of the potato disease. Sensible farmers are already avoiding the cultivation of susceptible varieties, the growing of which has been prohibited for many years in the affected areas. If, however, one were not completely successful in the elimination of the potato wart, the reason frequently lay in the fact that immune and susceptible varieties were frequently compared. It was only when more consideration was given and the question of varietal purity that the cultivation of immune varieties proved to be effective. As there is no other preventive method known, the task of the plant protection service is to see that only immune varieties are planted in the threatened regions. For this reason the testing of the identity and purity of the varieties has entered the field of the plant-protection service.

The same is true in combating the potato scab. In this instance, also, there are immune varieties, the tubers of which are more easily sold than those of the susceptible varieties.

The identity and purity of the varieties is important not only in combating the diseases by the cultivation of immune varieties, but also in other instances. For example, the mistaking of early potatoes for a variety which is late in ripening can mean great loss to the farmer, since early potatoes generally bring higher prices than late potatoes. Among the late varieties of food potatoes also there are some which are more valuable than others. In western regions of the country the yellow fleshed potatoes bring higher prices than the white fleshed varieties. It is true also that, among the yellow varieties, there are special favorites which bring the highest prices.

If one now considers that there are approximately 200 different varieties of potatoes in Germany and that several are planted side by side on most of the farms, one can understand how confusion and mistakes can occur. For this reason it is to be recommended that the identity and purity of the varieties be tested before the tubers are planted.

For this purpose the agricultural groups have instituted a certifying service. The first examination takes place at the time of blossoming, since one can best recognize the varieties at this time by means of the petals and the blossoms. At the second examination, which is undertaken shortly before the maturing of the vines, the tubers are tested at random. A certification of the resulting determination of the variety is then issued.

After the harvest, the tubers only are available for tests. One can distinguish the larger groups of tubers, by the color of the skin and flesh, and by their shape. In general, however, one can not differentiate the individual varieties; for example, there are a great number of varieties having tubers with white skin, yellow flesh, and a round form. These, however, may be distinguished by the peculiarities of the sprouts. If one wishes to investigate the identity and purity of a tuber, it should be germinated in the light. In the autumn several weeks are required before the sprouts are large enough; on the other hand, in the spring they develop sufficiently in 8-10 days and usually the variety may be recognized after 3-4 days. The characteristics of the light germination through which one can conclude the classification of the tuber, consists in differences in color, form, and fuzziness of the sprout. The color is either pure green or more or less reddish-brown or bluish-violet. The lower portion of the sprout is globular or pear-shaped, while the upper portion, which forms the bud, is short and pointed or long and well developed. A hairiness is either not to be observed at all, or is definitely well developed. There

are still a number of other characteristics into which we shall not proceed in detail. The testing by light germination has been worked out by the author in the National Institute for Land and Forest Economy in Berlin-Dahlem. However, it is used not only here but in all principal stations for plant protection which are distributed throughout the country.

Along with the varieties already existing in commerce, all newly developed plants are tested for their authentic variety; that is, it is determined whether they are really new varieties or simply old varieties under new names. All synonymous varieties are no longer acknowledged and have thus disappeared from trade. In these investigations also, the light germination test has performed valuable services.

MUCKLAND POTATO PRODUCTION IN NEW YORK

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Last year over 6000 acres of potatoes were grown on muck soil in New York. This is nearly 3 per cent of the total potato acreage in the state. Of the total muck potato acreage, one-third is grown in Wayne County and about one-fourth in the Elba district. Other important areas include Canastota, South Lima, Washington County, Burns-Arkport and Orange County. The acreage of muck potatoes is increasing annually. This trend seems to vary as the public demand for muck potatoes increases and in accordance with the farm prices of other muck crops the year previous.

Quality Improving

For many years there was a more or less justified prejudice against the quality of muck potatoes. This was due to the unpleasing appearance caused by muck adhering to the tubers and to a tendency to occasional sogginess in the cooked product. Such prejudice is no longer justified. Most of the crop is now grown on well drained muck with a resulting high cooking quality. Cooking tests to compare muck with upland potatoes have shown the former fully equal to the latter. Several of the larger growers have installed brushing machines to improve the appearance of the skin. With the one exception of sunburn injury, muck potatoes are freer of tuber defects than the average crop grown on upland soil. To reduce sunburn in the market product, growers are urged to plant deeper, to ridge the rows late in the season,

and to exercise more care in sorting out the affected tubers at grading time.

Soil Management Problems

In a recent muck crops' show at Warsaw, Indiana, W. K. Gast of Akron, Ind., won high honor with a yield of 555 bushels of which 443 bushels graded U. S. No. 1. This by no means would be a record for some of our own New York growers who have recently obtained a crop grading 95 per cent U. S. No. 1. The world's record yield of 1156 bushels per acre was made on a measured acre in 1933 by R. C. Zuckerman of Stockton, California. Such yields of a quality crop mean low cost of production per bushel and encourage potato production to compete with other muck crops. But cost per acre is high and such yields involve close attention to fertilizer practice, full stands of healthy plants and efficient soil management.

Deep well-drained muck is essential for high quality. Most of the muck now used for potatoes tests slightly acid (pH 5.8 to 6.15). This means that in general acidifying fertilizers are suitable, in fact recommended. Where scab is troublesome, nitrate of soda as a source of nitrogen should not be used either in the fertilizer mixture at planting time or as a side dressing later.

On lands which have been cropped and heavily fertilized for more than 10 years, the recommended fertilizer practice is quite different from that for new muck. Old muck is usually deficient in available nitrogen and contains some residual potash while new muck seldom needs much commercial nitrogen and is likely deficient in potash and phosphoric acid. Results are available from a potato fertilizer experiment of two years duration in Wayne County. Manured muck fertilized for celery in 1931 with 1000 pounds of 4-8-12 mixture, gave no increased yield of potatoes following application of potash in 1932. Nitrogen gave an increase up to 2 per cent in a ton (40 pounds actual nitrogen per acre) whereas 4 per cent (80 pounds N.) gave no increase over 2 per cent. Well rotted stable manure used on old muck seems to be effective. Last year a similar experiment on the same type of muck gave somewhat different results. With no manure and with potatoes following potatoes which had received a 1000 pound application of 4-8-12 fertilizer, profitable increases were obtained from a limited amount of all three elements. Using 1 ton applications, 2 per cent nitrogen, 4 per cent phosphoric acid and 8 per cent potash paid best. In other words, a 1000 pound application of a 4-8-16 fertilizer would have been the best treatment under the conditions of this particular experiment.

Tests with green manure cover crops of rye are to be made in several areas this year. For the older mucks, growers are reminded that rye seeded immediately after potato harvest may provide an economical and a profitable source of nitrogen.

GROWING SEED POTATO FOUNDATION STOCK

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The development of the certified seed potato industry in the United States and Canada has gradually produced a small group of what might be rightly designated as super-growers, or those who are willing and capable of exercising every precaution possible in order to obtain, as nearly as may be, disease free seed. This type of seed is commonly referred to as foundation stock For the most part it is sold to commercial growers of certified seed to plant the necessary seed plot acreage for their ensuing year's commercial crop. The adoption of such a practice by the commercial growers relieves them to a large extent, at least, of the necessity of exercising the extreme care that is essential to the maintenance of high grade seed. In fact, if the foundation seed is of the quality it shou'd be and the seed plot is properly isolated and rogued, it is often possible to meet the certification requirements in their commercial fields with little or no roguing.

On July 30, the writer enjoyed the privilege, as the guest of the Presque Isle, Maine, Rotary Club, of inspecting a farm in Masardis, Maine, where some fifty-five acres of Green Mountain potatoes are being grown. This farm consisting of some 545 acres was purchased by a seed potato firm in the Fall of 1930 for the express purpose of producing foundation seed stock. It is located in a more or less dense forest of which it was a part and is isolated by over a mile of forest surroundings on the east, extending to Quebec on the north and by a good many miles on the south and west. It would seem, therefore, that from the isolation standpoint, at least, the farm is ideally located so far as adjacent field transmission of diseases is concerned.

In 1931 five acres in three different plots were cleared and planted on the tuber unit basis and thoroughly rogued throughout the growing season. From these five acres, 662 barrels (1820.5 bushels) were harvested. By the spring of 1932, some 50 acres had been cleared of which 47.7 acres were planted by hand on the tuber unit plan with seed from the previous year's 5-acre seed plot. In the Fall, 6107 barrels were harvested from the above acreage or an average of 128 bar-

rels (352 bushels) per acre. While this yield is not a large one as yields go in Aroostook County, Maine, it is by no means small when one takes into account the fact that a blank space or missing plant occurred between each tuber unit as well as the additional reduction in yield due to the entire removal of all diseased or weak units.

In 1933, an even 50 acres were planted, as in the previous seasons, on the tuber unit plan with a resultant crop of 6019 barrels or an average of nearly 120.4 barrels (331 bushels) per acre.

The 1394 planting embraces approximately 55 acres and on the date inspected gave promise of an excellent yield. It may be of interest to know that this firm have in their employ a plant pathologist and an assistant, who give their undivided attention during July and August to the removal of all diseased units or off-type plants.

The seed from this farm has not been planted only in nearly all sections of Arookstock County but as far west as Denver, Colorado. Massachusetts growers are credited with being the largest purchasers of this high grade seed. If one may judge from the enthusiasm of the two owners of the Forest Foundation Seed Farm, there is every reason to believe that the enterprise is a success both financially and otherwise. Perhaps one of the most encouraging results secured has been the demonstration that thus far at least it has been possible to continue growing the same seed stock in Aroostook County without an apparent increase in disease content.

SECTIONAL NOTES

CALIFORNIA

The developments in California substantiate the predictions I made last month. The late crop in the Stockton District is in a deplorable state. A very small percentage of these potatoes will be suitable for market purposes.

The quality of potatoes in the Yakima District of Washington is al o very poor and the yields will be less than last year. Wireworms and other insects have materially damaged the yield and quality of these potatoes, with the result that 25 to 30% are absolutely worthless except for animal feed and the balance of the crop will grade about 50% No. 1's and 50% No. 2's.

The growing conditions in the Klamath District in Oregon have been good. There is an increase in acreage with the result that this district will probably ship 1000 carloads more than last year. The quality is very fine, in fact, the Klamath District is the only district

that will have fancy Netted Gem potatoes. The Netted Gem crop in Idaho is of comparatively poor quality and it is still too early to definitely estimate the yields but it is safe to say that climatic conditions have not been conducive to a full fancy crop.

At least 75 to 80% of the vines in Red River Valley Sections of Minnesota and North Dakota were killed before September 8 either by frost or lack of moisture. It is impossible for any amount of increase in tonnage on at least 75 per cent of the acreage, regardless of weather, the balance of the season. On the vines that died from lack of moisture the yield is very light. On the frosted vines the average set is about three potatoes—good smooth quality and about 2" to 3" in size.

If there has been no increase of acreage in the Red River Valley the total yield will be less than last year. (September 14).—H. G. ZUCKERMAN.

COLORADO

The potato situation here in Colorado is the worst that it has been since 1911. Psyllid yellows was prevalent in practically all the larger growing districts, and there were not enough sprayers available and growers were not adequately financed to take care of the condition. The drought has also seriously injured the crop in practically all districts. In addition to the above two unfavorable factors, all crops in the higher altitude, including the San Luis Valley, were frozen down on September 2. Yields will be extremely low, size of the tubers will be small and the percentage of culls will be unusually high because of psyllid and drought damage.

Unless prices are very good, the San Luis Valley, which ordinarily ships 10,000 cars, will probably not ship more than 2,000 or 3,000. The seed crop will be light and will probably not exceed last year's in spite of the fact that we have a 40 per cent increase in acreage.

The non-irrigated crops in the eastern part of this state are practically a failure, and the crops grown under irrigation will not exceed 50 per cent of normal. (September 8).—C. H. METZGER.

IDAHO

It looks as though 1934 would go down in history as being a bad potato year for Idaho. Poor stands to begin with, more or less shortage of water through the season and excessive temperatures during July and August have given Idaho potatoes a jolt from which they

will hardly recover. However, the next three weeks may show some improvement. As it now stands, I believe that our crop will be considerably less than last year even with an increase in acreage. My estimate is not more than 25,000 cars.

I visited one of our leading districts last week and found that the high temperatures of the past month have caused a rather heavy percentage of vascular infection, probably fusarium, in all the earlier planted stock and some in that of a later planting. This will tend to reduce yield. Probably the greatest damage from the heat is that of misshapen and off-grade potatoes. This is more or less apparent in all fields, even to the extent that many of our growers in some districts are expecting, not over 50 per cent No. 1's.

I hope that I can give a more favorable report a month from now but at present the conditions are decidedly unfavorable.

The same thing is more or less true with our seed crop, particularly in the unirrigated districts where considerable areas of the fields have dried up without making any tuber set that can be harvested. Hence, we are expecting a very much reduced out-put of certified seed. (September 10).—E. R. BENNETT.

INDIANA

Late rains and cool weather give promise for a much better crop than expected, provided frosts hold off. There is a good set but we will need the remainder of this month to mature the crop nicely. Our late cobblers are being harvested now and most of the Rurals will be dug between September 1 to 15. The present indications are that our total crop will be approximately 4,000,000 bushels and we will need some 6,000,000 or 7,000,000 bushels for both stock and seed. (September 12).—W. B. WARD.

KENTUCKY

Although abnormally warm weather prevailed in the Lexington district at planting time (July 25 to Aug. 10) the soil was in splendid condition and stands were exceptionally good. Growing conditions have been excellent and the fields were in full bloom September 1. The tubers are setting well and prospects are better than in any year since 1929 when Kentucky had the best crop for a generation.

Owing to the lack of rain in the Louisville district the soil was exceedingly dry and some growers did not complete planting until Au-

gust 20. The stand averages about 80 per cent and since the rains the crop is growing well. If there is not a killing frost before October 15 there should be good yields in all except the late planted fields. (September 8).—JOHN S. GARDNER.

MAINE

At the completion of the second inspection the following acreages had passed:—Green Mountains, 6,622¼; Irish Cobblers, 7,435½; Spaulding Rose, 1,249⅛, and all others, 700⅔.

Digging is going along as well as the weather will permit and the average yield will be high. There are some sections that will have a lower yield due to the lack of rain. Some growers are planning to secure foundation stock for next year because they had tried to maintain their own a little too long without tuber unit work. There was a smart demand for seed ten days ago but it seems to have quieted down the last few days. Advertising campaigns are being planned by this Department for certified seed. (September 17).—E. L. NEWDICK.

MASSACHUSETTS

The cobbler crop is harvested and has been moved into market in most cases. Returns in general have been disappointing at the wholesale farm price around 85c per 100, with yields only normal or in some cases low, due to insects and dry weather Contrary to the attitude of most growers to get rid of cobbler supplies as soon as possible, a few instances of storing are reported.

The Green Mountain crop is about ready for harvest. On many fields, vines are completely dead as a result of insect damage. Thoroughly sprayed fields are still green. While late blight has not been especially noticeable on vines, some evidence of blight rot is now showing up on tubers. Recent rains and weather conditions may develop further rot. Present prospects are for a normal yield of Green Mountains with a disposition on the part of many growers to delay harvesting in anticipation of some slight pickup in market prices. (September 18).—RALPH W. DONALDSON.

MICHIGAN

According to the September 1st report, Michigan will have this year about 22,950,000 bushels of potatoes. The September estimate is about 2,700,000 bushels above that of August 1st. Last year, the final estimate for Michigan was 20,670,000 bushels.

Since early in September, we have had good rains throughout most sections of the state, especially in the northern portion of the lower peninsula and in the upper peninsula. However, rains came too late for the production of many four hundred or five hundred bushel yields There will, however, be a few of these in the upper peninsula and perhaps a few in the northern portion of the lower peninsula. Michigan has experienced considerable damage from frost, many fields having been pretty hard hit about the 21st or 23rd of August. Then later, severe frosts struck pretty well throughout the northern sections of the state during the first week in September.

The general run of potatoes this year may be small in some sections, due to late planting on account of severe drouth early in the season and early frost, which has killed or injured the vines in many instances.

During the last two years, there has been considerable development in the certified seed work in the upper peninsula and this year there are several new certified seed warehouses being erected along side tracks. It is believed that the certified seed crop in Michigan will be about the same as last year in total bushels. There is an increase of approximately 350 acres over last year, but the yields will not be quite so good and rejections will run somewhat higher.

Many fields in southern Michigan in the areas most severely affected by drought show plants badly wilted, apparently a sun-burn or dry weather condition, as fusarium wilt and other fungous organisms do not seem present in the plants.

The Potato Field Day at the Lake City Experiment Farm was held yesterday, September 12th. Approximately 1500 potato growers from all sections of Michigan attended the meetings and visited the experimental plots. It is planned to make this event an annual one. (September 14).—H. C. Moore.

MONTANA

Continued drought has cut yields very materially in the dry land areas east of the Continental Divide. Some of the fields will not be worth harvesting, except to save seed stocks for next year's planting.

Most of the Netted Gem acreage entered for certification is in the Flathead districts of western Montana where irrigation is not practiced. This part of the state has fared much better than eastern Montana. Yields will be somewhat below those of last year. Tubers are running small but the set and type are very good. Frost in late August damaged a few fields.

The irrigated valleys average somewhat below normal yield due to thin stands in some fields and water shortage in others.

A cultural practice of interest to growers this season is depth of planting. The deeper planting is favoring better tuber type, perhaps more so this year than in normal seasons.

The application of phosphate is again proving its worth in increased sets and better type of tubers in those areas showing a deficiency of this plant food element. (September 12).—E. E. Isaac.

NEBRASKA

The cool weather which began about the 20th of August and has continued to date, came too late to be of any value whatsoever in the southern and eastern part of the state. In this portion of the state with the exception of irrigated potatoes, there are very few fields that will return more potatoes than were planted and some of them are absolute failures. In this connection the writer has had a big surprise in connection with the performance of some of the fields which were being grown with irrigation.

One field in particular, planted with the Irish Cobbler variety, yielded over 100 bushels per acre despite the fact that maximum temperatures were as high as 118 degrees with a maximum every day except one of over 100 degrees, from July 5th to July 24th. On that one day the maximum was 98. During the last week in July there was a slight reduction in temperature accompanied by rain. This and one cool spell in the early part of July was about the only time during which the potatoes could possibly have stored any reserve material in the tubers. The resumption of hot weather during the first two weeks in August destroyed the vines. This incident is mentioned because it seems to indicate that good crops of potatoes can be produced in very hot weather if water is available to the plants.

The situation with regard to the western crop has not changed very much. There has been a limited amount of rain in the various districts and the plants are still alive. The temperatures have been very favorable for potatoes. If we get any rain there may still be quite an increase in yield providing of course that early frosts do not occur. With the condition that the potatoes are in now however, late rains are very certain to increase the turgidity of these potatoes to such an extent that they will crack very easily at harvesting time and will consequently be very difficult to handle. (September 11).—H. O. Werner.

NEW JERSEY

Sixty-four growers entered 755 acres for cerification this year. These potatoes were planted between July 25 and August 10. Growing conditions have been excellent and prospects for a crop are good. The first field inspection has been completed and few fields were rejected because of diseases. A number of fields were found to show no virous diseases.

Harvesting the main crop has proceeded slowly. An effort was made last week to raise the f.o.b price to $1.00 a hundred; some sales were made at this price but the demand was slow due to the fact that potatoes from other sections could be purchased for less. Today the price is 90 cents a hundred f.o.b. It is raining and the dealers in the sales office think they can move those on track at this price. Latest estimates show that approximately 80 per cent of our crop has been moved. The price has ranged from 85 cents to $1.00. Yields have only been fair, and at these prices the growers have not paid their seed and fertilizer bills. Growers and dealers alike are convinced that the price would have been lower without the Central Sales Office. The New Jersey growers are of course concerned about the fact that they were compelled to pay much more for their supplies but sold their crop for less than half of last year's price. Many of our leading growers feel that some adjustment must be made but there is no agreement as to the plan to adopt. The feeling seems to be rather general, however, that if the manufacturers of agricultural supplies can fix prices, the potato grower should have something to say concerning the price he receives.—(September 17).—WILLIAM H. MARTIN.

NEW YORK

In Northern New York probably ten per cent of the fields have been damaged by severe frosts. Due to the unusually dry weather prevailing throughout most of the potato area in this section it is doubtful if there will be more than eighty per cent of a normal crop. Around Gabriels more than three-fourths of the acreage was killed the last week in August by freezing.

In Western New York conditions are so spotty it is difficult to form an opinion. This much may be said, however, the potato crop in this section needs two to three weeks of good growing weather before frost in order to approximate a normal crop.

Around Gainesville many fields were damaged and some were

killed by frost late in August. The set is quite light in many fields, good tops, but nothing under them. If I should hazard a guess under present conditions, it would be that upstate New York will produce a crop about twenty per cent below the five year average.

Some fields of early planted Green Mountains are being dug for table stock in Steuben County. The vines are dead, or nearly so, because of lack of water and curtailment of the spray program. On farms usually producing 300 bushels, or better, they are digging 200 to 250 and not very fancy stock. (September 15).—J. R. LIVERMORE.

The acreage entered for certification this year is as follows: Irish Cobbler 484; Late Cobbler 30; Green Mountain 552; Smooth Rural 669; Russet Rural 548; Miscellaneous 79.—KARL H. FERNOW.

NORTH DAKOTA

Following are the acres of various varieties entered for certification. A portion of this acreage will be rejected before the season is completed:

Bliss Triumph	3,892	White Gold	12
Irish Cobbler	3,468	Rural New Yorker	5
Early Ohio	2,763	Green Mountain	1
Viking	21½	Warba	½

The yield of our crop has been affected considerably by drought, especially in the western portion of our state. We are not expecting the yields to average more than 75% of that obtained last season. It is hard to estimate however, just how much the yield will be increased as the result of some recent rains. We are expecting the quality to average just as good, perhaps a little better than last year. (September 8).—R. C. HASTINGS.

PENNSYLVANIA

Conditions at this date are much improved over August 1st. The September 1st crop estimate will doubtless show about a normal yield. Early potatoes turned out well, save in the driest sections of the western counties. The late crop has had adequate rain recently throughout most of the State save in Lehigh and Northampton counties. Rain in the latter counties on September 8th was too late to help the unsprayed fields which had been dead for some time. Well sprayed fields were

still green and had an excellent set but the size was too small for very large yields.

For the northern counties such as Potter, early development was slow due to deficient moisture. Some fields are still in bloom with a good set but with few first size tubers. The temperature fell to 30° in some places in Potter county on the night of August 29th, but little damage was done to the potatoes on higher elevations. More moisture and a month of growing weather is needed to develop some fields properly. (September 11).—J. B. R. DICKEY.

We are expecting a larger crop of certified seed potatoes in Pennsylvania this year than we ever grew before. While we have already experienced frosts in several of the seed-producing counties, the damage to the seed fields has been quite negligible.

Last year we had 687 entered for certification of which we certified 425. We make three field inspections of our certified seed fields in Pennsylvania. At the completion of the second inspection our records showed the following approximate results for 1934.

Total acreage entered—879.5.

	Certified	*Rejected*
Green Mountain	0.5	2.5
Irish Cobbler	74.5	51.0
Mason White Rural	148.75	53.0
Russet Rural	413.5	96.75
White Rural	25.5	13.5
Total	662.75	216.75

While several rejections were made throughout the state because of disease, most of them were turned down because of poor stands, weak plants, weeds, improper isolation, etc. Late-planted fields generally came through with very poor stands because of the high temperature and drought during June and July. While many of the seed fields received a fair amount of rain all summer, others had practically no rain until after August 1. Since August 1, growing conditions have generally been very good. While traces of late blight have been found there has been no damage to any of the seed fields up to this time.

Late-planted fields show good sets and fine prospects of turning out good crops of smooth tubers with very little over-size. In the earlier-planted fields the dry, hot period came during the time when the plants were setting tubers, with the result that some fields showed

poor sets. It is also anticipated that the earlier-planted fields will produce a rougher crop with some second growth and a heavy percentage of over-sized tubers.

Growers are reporting prices of fifty to seventy-five cents per bushel for table potatoes. While few prices have been quoted or offered for seed, there appears to be considerable interest in the crop. Large growers and dealers have been visiting seed fields in the seed-growing counties. (September 4).—K. W. LAUER.

VERMONT

Six hundred and sixty and one-half acres were certified. Although the early part of the season was hot and dry making inspection of virous diseases rather difficult, good checks were obtained later in the season when we had some rains. Ninety-one samples were entered in the central test plot at Randolph Center and gave a good general index to the fields planted from the stock they represented. Leaf roll was the most serious of the diseases encountered this year. A few cases of yellow dwarf and some infection of a form of wilt, yet to be identified, were among the unusual features. No late blight was found during the season although little or no digging has been done at this time. It is my opinion that there will be at least an average yield from the certified fields. Leafhoppers were unusually scarce but flea beetles were very abundant late in the season and caused a considerable amount of foliage loss. (September 12).—H. L. BAILEY.

WASHINGTON

The present indications point to a decrease in the quantity of certified seed potatoes grown in Washington this year. We have had unfavorable growing weather for potatoes, coupled with an early infestation by insects. The prevalence of a large number of insects early in the season has resulted in a large amount of current infection of virous diseases which in turn has made it necessary to disqualify more fields than common. Although we had an approximate increase of 25 per cent in acreage over the 1933 crop, present indications point to a probable decrease in the quantity of seed potatoes of about 20 per cent.

In addition to the above, there is considerable late blight appearing at the present time which may possibly further decrease the available seed supply. (Sepetmber 11).—CHAS. D. GAINES.

WISCONSIN

Since the last issue of the Potato Journal the weather conditions in Wisconsin have been very changeable and a very wide variation has prevailed over the central and northern part of the state that makes it very difficult to estimate present crop prospects.

In general, conditions in the central, north central and northeastern sections of the state are satisfactory in regard to vine growth and moisture. However, in the north central and northern area considerable damage resulted from frosts occurring late in August and these frosts have reduced the crop in several sections. The northwestern area of Wisconsin was most severely damaged by drought and heat of midsummer and the recent rains have occurred too late to save the crop in several sections.

At this date we would not attempt to submit an estimate of crop conditions on account of the uncertain losses that have occurred from drought and recent frosts. The type and quality of Wisconsin potatoes, however, on the average is much improved over the 1933 season. With continued favorable weather for the next four weeks, Wisconsin potato conditions should be fairly satisfactory. (September 5).—J. G. MILWARD.

CANADA

Reports compiled to date indicate that approximately 20,000 acres have passed field inspection with a view to certification in Canada this season as compared with 18,600 acres passed in 1933. Accurate figures on yields are not yet available, but it is expected that approximately the same quantity of certified seed will be available this year as last.

In New Brunswick the acreage which passed inspection was: Green Mountains 1,950 acres, Irish Cobblers 890 acres; Bliss Triumphs 739 acres, other vareities 6 acres. The crop is of excellent quality. (September 15).—JOHN TUCKER.

THE PRICE SITUATION

The following report on potatoes was released on September 15 by the Bureau of Agricultural Economics of the United States Department of Agriculture.

Prospects for late crop potatoes improved somewhat during the past month and market prices remained fairly steady. The New Jersey crop and the early maturing varieties from some of the late pro-

ducing states were the principal sources of market supply. Shipments from the main crop of the late states, however, may be expected to increase shortly and prices are likely to decline seasonally until the fall peak movement is passed. Owing to the shortage of potatoes in the Far West, it is likely that prices in central and western markets will continue to average higher than those in the eastern centers.

Potato prospects improved during August in the Eastern and North Central States but deteriorated in the Far West. The forecast as of September 1 indicates a total production for the United States at 337,000,000 bushels compared with 320,000,000 harvested in 1933 and 366,000,000 the 1927-1931 average. As compared with 1933 the potato crop is larger in the three Eastern Surplus States by 9,500,000 bushels, and in the five Central States by 7,500,000 but smaller in the Far West by 15,500,000 bushels. Production in the 12 other Late States is expected to be about 2,000,000 bushels larger than in 1933, so that in general, there will be almost an average supply of potatoes this season east of the Rocky Mountains.

Recent weekly car-lot shipments have averaged about the same as in 1933 or about 2,500 cars per week. Shipments to date from the Late States, however, total slightly less than to the corresponding date a year ago. Those from the Intermediate and Early States have far exceeded those of last year. The car-lot and boat movement of the 1934 crop from all states totaled 72,680 cars to September 8 compared with 57,568 cars to September 9, 1933.

Potato prices at market centers show little change from those of a month ago. At New York they averaged 96 cents per 100 pounds for the first week of September compared with 95 cents for the first week of August and $2.15, the first week of September 1933. At Chicago they averaged $1.36 per hundred pounds in the first week of September compared with $1.40 the first week of August and $1.81 a year ago. The higher prices at Chicago this year compared with New York are attributed to the fact that production in the areas which usually supply this market with potatoes at this period are unusually small, whereas there are large supplies in the areas serving the eastern markets.

Shipping point prices in New Jersey, the only market open at this time, declined from $1.00 per 100 pounds the first week in August to 85 cents during the first week in September.

Farm prices of potatoes for the United States averaged 68 cents per bushel on August 15 compared with 66.9 cents a month earlier, $1.31 a year earlier and 84.5 cents the August average 1910-1914.

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THE ANNUAL MEETING

The Potato Association of America will meet at Pittsburgh on December 27, 28 and 29. The William Penn Hotel has been chosen as headquarters. This hotel will also serve as the headquarters for the Botanical Society of America, the American Phytopathological Society as well as others. In view of this fact, reservations should be made early. The hotel will be able to provide about eight hundred rooms at $3.00 to $3.50. In addition, they will provide from a hundred and fifty to two hundred rooms with twin beds at $6.00.

The program on Thursday will be devoted to committee reports and miscellaneous papers. On Friday morning, we hope to arrange for a discussion of the various proposals to regulate the potato industry. In this connection, it is of interest to note, as reported in the Sectional Notes of this issue of the Journal, that the growers in certain of the Southern States have already made suggestions as to how the industry should be regulated. These suggestions are worthy of serious consideration. Other plans will no doubt be presented by the various potato growing sections in the next few months and it is hoped that these too may be thoroughly discussed at the Pittsburgh meeting and a plan evolved which will be satisfactory to most of the potato growing sections.

On Friday afternoon, there will be a joint session with the American Society of Horticultural Science. On Saturday morning and afternoon, joint sessions are being arranged with the American Society of Agronomy and the American Phytopathological Society, respectively.

We are attempting to arrange the program so that it can be printed and in your hands prior to the meeting. In view of this fact, titles of papers to be presented should be submitted to the Secretary as soon as possible. The papers presented at the annual meeting will be printed in the American Potato Journal during the coming year.

In view of the many changes that are likely to take place in the potato industry in the next year, the Pittsburgh meeting promises to be very important. It is hoped that there will be a good attendance so that these matters may receive the consideration they deserve.